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WORK PLAN GEOTECHNICAL SAMPLING AND TESTING SOLID WASTE LANDFILL AND ON-SITE WASTE DISPOSAL CELL FOR OPERABLE UNIT 2 OCTOBER 5, 1993

11/08/93

DOE-FN/EPA
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WORK PLAN
OU2

WORK PLAN

GEOTECHNICAL SAMPLING AND TESTING

SOLID WASTE LANDFILL
AND
ON-SITE WASTE DISPOSAL CELL
FOR
OPERABLE UNIT 2

October 5, 1993

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TASK 1: GEOTECHNICAL SAMPLING AND TESTING ACTIVITIES AT SOLID WASTE LANDFILL FOR OPERABLE UNIT 2

1.0 GENERAL

1.1 Summary

The Work Plan for Operable Unit 2 (OU2) Geotechnical Sampling and Testing has been developed to implement a post-screening geotechnical investigation to obtain remedial design data for evaluation of the Solid Waste Landfill (SWL). This investigation, hereinafter called a predesign field investigation (PFI), will include both geotechnical and environmental sampling. Laboratory analysis and data evaluation will be performed to support the PFI. Information obtained from the PFI will be used to design one of two remedial alternatives, as follows:

- Removal of waste by excavation within localized areas with high concentrations of radionuclides, as delineated by remedial investigations, together with capping of the landfill.

- Removal of all waste by excavation to clean closure and backfill of the pit to grade. Disposal of select excavated material in an on-site RCRA type cell. The geotechnical exploration for the waste cell is defined as Task 2.

1.2 References

The environmental work associated with this Work Plan will make use of protocols set forth in the Fernald Environmental Management Project (FEMP) Sitewide CERCLA Quality Assurance Project Plan where appropriate.

Work will conform to health and safety requirements as specified in 29CFR1910 and 1926, and as documented in the FEMP's Site Health and Safety Plan.

Field radiological contamination surveys will be conducted in accordance with FEMP Health and Safety Department procedures.

The publications listed below also form part of this Work Plan:

- ASTM (American Society for Testing and Materials) Standards

- U.S. Army COE Earth Manual

2.0 SITE CONDITIONS

2.1 Previous Investigation

The SWL has been subject to the following previous investigations that will be reviewed and incorporated in the geotechnical data evaluation as appropriate.

- Characterization Investigation Study. Vol 1. Geophysical Survey by Roy F. Weston, Inc., October 1987.
- Remedial Investigation for Operable Unit 2, October 1992.
- Results of Characterization Trenching in the Operable Unit 2 (OU 2) Solid Waste Landfill, November 1992.
- RI/FS additional sampling and analyses in accordance with Sampling and Analysis Plan for RI/FS Work Plan Addendum, Operable Unit 2, April 1993 (in progress, July 1993).

The exploration locations of previous investigations are shown on the attached Figure 1, Solid Waste Landfill, Sample Locations.

2.2 Landfill Material Characteristics

The landfill includes both soil and waste components. The maximum depths of the waste as determined from the previous investigations is about 17 feet. The observed depth to the interface between the waste fill and undisturbed natural soil is indicated on Figure 1.

- The types of materials identified during trenching include bagged and loose asbestos materials, ceramic tiles, glass acid bottles, possible magnesium fluoride, rubber hoses and tubing, medical waste, fire hoses, steel cables, full and empty paint cans, suspect radiologically contaminated yellow material, asphalt roofing material, respirator cartridges, and copper tubing. Approximately 25 percent of this waste material was classified as burnable, with the remaining 75 percent of the waste as non-burnable. The actual percent of non-burnable material, including the soil, for the entire landfill is estimated at ninety percent.
- The soil materials mixed in with the waste consists predominantly of silty clay with some clayey silt and silty sand. Those soil materials are of similar classification to the in-situ soils at the SWL site. The consistency varies typically from stiff to hard and the moisture content varies between moist and dry except at localized areas where zones with perched water was encountered.

3.0 EXECUTION

3.1 Field Exploration

3.1.1 Geotechnical Field Work

The planned boring locations for the geotechnical field work are shown on Figure 1. The investigation objective for each boring, the planned depth and notes regarding sampling and depth termination are provided in the attached Table 1.

Shelby tube samples will be obtained according to ASTM D1587, and Standard Penetration Tests with split barrel sampling will be performed according to ASTM D1586 at the frequencies noted in Table 1.

The actual boring locations will be based on the available information from previous investigations and consider the following criteria:

- Borings G2-101,-103, and -105 will be located between the edge of the landfill and the railroad track to provide samples for strength determination of the natural ground, at the excavation slopes for waste removal, or alternately at shallow depths for cap stability.

- Borings G2-102,-104, and -106 will be located such that the borings intersect the lower part of the original landfill pit excavation slope. The purpose for these borings is to obtain indications of the location and required steepness of the excavation slope for waste removal towards the railroad tracks.

  One sample for consolidation testing will be obtained in Boring G2-106. The sample for consolidation testing will be taken from soil materials encountered above the bottom of the waste.

- Borings G2-107,-108,-109, and -110 will be located to provide samples for strength determination of the natural grounds at the excavation slopes for waste removal, or alternately, for cap stability. Samples for consolidation testing will be obtained from the silty clay layer in Borings G2-107 and -109.

- Borings G2-111,-112, and -113 will be located at a distance of 30 to 60 feet from the existing railroad tracks, to provide information for possible track relocation design.

- Borings G2-114,-115, and -116 will be drilled to recover undisturbed samples of natural soils classified as ML for hydraulic

conductivity testing. The samples will be obtained in the first silty layer encountered below the bottom of the waste.

One sample for consolidation testing will be obtained in Boring G2-116. The sample for consolidation testing will be taken from soil materials encountered above the bottom of the waste.

3.1.2 Environmental Field Work

The planned borings 11042, 11043, 11044, and 11045 for the environmental field work are shown on Figure 1. An auger rig will be used to drill the bore holes and a 6 inch diameter CME sampler will be used to collect continuous samples. Samples for on-site laboratory analysis will be collected for total Uranium only if beta-gamma field instruments detect levels 10 times background, or if waste material is encountered. Drilling will continue through the waste/fill material until the underlying native material is encountered. The anticipated depth of the environmental borings is in the range of 12 to 20 feet.

3.1.3 Personal Protective Equipment

The SWL is currently designated as a "surface contamination area". Personnel conducting drilling operations within the SWL will wear Level C Personnel Protective Equipment, consisting of Tyvek suits, full faced respirators, rubber overboots, and polyethylene gloves with cotton overgloves, Saranex suits are required in place of Tyvek suits if water is encountered or if precipitation is expected. All personnel working in the surface contamination area are required to have Radiological Worker II Training. This personnel must sign off on the Radiological Work Permit with the FERMCO Environmental Safety and Health Division, Radiological Control.

3.2 Laboratory Testing

3.2.1 Geotechnical Laboratory Testing Program

The planned laboratory testing program is defined in Table 2. The samples actually selected for particular tests will be determined based on the encountered soils conditions and sample characteristics. The geotechnical testing procedures are summarized in Table 3.

Based on the test assignments indicated in Table 2, the approximate number of tests to be performed for each method is as follows:

TEST METHOD	NUMBER OF TESTS
Moisture Content	21
Grain-size Analysis (SA/HA)	22
Atterberg Limits	22
Triaxial Compression (UU) (3 specimens at different confining pressures)	3
Triaxial Compression (UU) (1 specimen)	6
Triaxial Compression (CIU, w/pp) Each CIU Test will include 3 specimens at different confining pressures	7
Hydraulic Conductivity	3
Unit Weight	19
Specific Gravity	4
Consolidation Tests	4

Samples will be sent to a geotechnical laboratory.

3.2.2 Environmental Laboratory Testing Program

If samples are collected from the environmental field work, the samples will be sent to the on-site FERMCO laboratory for total Uranium analysis. The quantity of sample needed for analysis will be coordinated with the laboratory.

4.0 PREDESIGN ACTIVITIES AND EVALUATION REPORT (PAER).

The data collected during the PFI, including data collected during previous site investigations and studies, will be the basis for the geotechnical analyses and design of the remediation actions. The findings of the PFI will be summarized in a Predesign Activities and Evaluation Report (PAER). The PAER will also contain all boring logs, laboratory test results and data evaluation.

The PAER will include, but not necessarily be limited to, the following information:

1. Description of laboratory tests

2. List of laboratory test procedures used and variations, if any.

3. Summary of laboratory test data indicating, when applicable:

- boring number
- sample ID
- sample depth
- USCS symbol (see note)
- dry unit weight (pcf)
- Atterberg Limits
- grain size distribution
- triaxial test type (CIU, UU)
  - -data - figure
  - - σ_3 (psi)
  - - $(\sigma_1 - \sigma_3)$ (psi)
- initial void ratio - e_o
- coefficient of Consolidation C_o

  NOTE: Field classifications according to ASTM D 2488 will be verified by comparison to ASTM D 2487 results.

4. Gradation curves

5. Triaxial test diagrams illustrating Mohr's circles (for total and effective stress (when applicable), rupture line, and strain vs. stress curves (when applicable)

6. Plasticity charts

7. Hydraulic conductivity test results including permeability vs. test duration

8. Consolidation test curves

The PAER will present geotechnical evaluations and recommendations regarding the location, depth and characteristics of the soil layers to be used for assessment of the slope stability conditions on all sides of the SWL during waste excavation, including the railroad, together with the corresponding design parameters for total shear strength (c,ø) and unit weight. The recommendation will include parameters for the alternate design of a cap placed over the SWL. Recommendations will also include design parameters for determining the railroad bed design for a changed alignment. Hydraulic conductivity of the natural silty soils below the waste will be presented as the measured permeability for the particular soil type and location.

The PAER will in a separate section include all boring logs and test results from the environmental work.

5.0 QA/QC PROGRAM

All environmental activities will be performed in accordance with the Sitewide CERCLA Quality Assurance Project Plan. The Analytical Support Level will be B for radionuclides.

The QA/QC Program for geotechnical activities will be separate and will consist of the following elements:

1. Management and supervisory overview to ensure compliance with all plans, procedures, rules and regulations, and referenced standards for performance of the Work Plan activities.

2. Organization and assignment of key personnel for execution of the Work Plan.

3. Training and qualifications of all assigned personnel relevant to their responsibilities, tasks and required skill level.

4. Procedures for the technical performance of all field and laboratory tests. Identification and implementation of recognized standards will satisfy this requirement.

5. Current calibration of all measurement and test equipment.

6. Control of all information and data to provide traceability from the origin to the final report.

7. Design control for all data compilations, evaluations, analyses, and report preparation including supervisory review, checking and technical peer review.

8. Procedures for identification and control of non-conformances from the QA/QC program requirements and resulting corrective actions.

TASK 1 - TABLE 1

GEOTECHNICAL FIELD INVESTIGATION PLAN

INVESTIGATION OBJECT	BORING NUMBER	PLANNED DEPTH (FT.)	NOTES
South Side	G2 - 101	30	(1)
Excavation	- 102	20	(2)(3)
Railroad	- 103	30	(1)
Stability	- 104	20	(2)(3)
	- 105	30	(1)
	- 106	20	(2)(3)
West Side Excavation	G2 - 107	20	(1)
North Side	G2 - 108	20	(1)
Excavation	- 109	20	(1)
East Side Excavation	G2 - 110	20	(1)
Railroad	G2 - 111	20	(2)
Relocation	- 112	20	(2)
	- 113	20	(2)
In-Situ	G2 - 114 (1984)	6	(4)(5)
Silt	- 115 (11040)	15	(4)(5)
Sampling	- 116 (11041)	14	(4)(5)

Notes: (1) Obtain Standard Penetration Tests with Split Spoon samples and undisturbed Shelby Tube samples alternately at 2.5 foot intervals.

(2) Perform only Standard Penetration Tests with Split Spoon sampling at 2.5 intervals.

(3) Terminate boring after 5 foot penetration into natural soil below fill bottom.

(4) Advance boring without sampling to 24-inches above designated depth and obtain undisturbed Shelby Tube sample. Obtain a second Shelby Tube sample if recovery of the first sample is less than 80%.

(5) 1984, 11040 and 11041 are reference borings. Planned borings to be located 3 to 5 feet from reference borings.

TASK 1 - TABLE 2

GEOTECHNICAL LABORATORY TESTING PROGRAM
PLANNED FOR THE SOLID WASTE LANDFILL

Sample Location	Sample Number	Estimated Depth(ft)	Screening	Chem/RAD	Resource Conservation and Recovery Act/Geotechnical					
			A	C	D	E	F	G	H	J
G2 -101		5-10			W,LL/PL SA/HA			CIU		γ_d
		10-15						UU1		γ_d
		15-20						UU1		γ_d
G2 - 102		10-15			W,LL/PL SA/HA					
G2 - 103		5-10			LL/PL SA/HA			UU1		γ_d
		10-15			LL/PL SA/HA			CIU		γ_d
		15-20			LL/PL SA/HA			UU1		γ_d
G2 - 104		10-15			W,LL/PL SA/HA					
G2 - 105		5-10			LL/PL SA/HA			UU1		γ_d
		10-15			LL/PL SA/HA			UU1		γ_d
		15-20			LL/PL SA/HA			CIU		γ_d
G2 - 106		6-8			LL/PL SA/HA	CON				
		10-15			W,LL/PL SA/HA					
G2 - 107		7-8			LL/PL SA/HA	CON		CIU		γ_d
		12-14			W					
		16-18			W					

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TASK 1 - TABLE 2 (CONTINUED)

GEOTECHNICAL LABORATORY TESTING PROGRAM
PLANNED FOR THE SOLID WASTE LANDFILL

Sample Location	Sample Number	Estimated Depth(ft)	Screening	Chem/RAD	Resource Conservation and Recovery Act/Geotechnical					
			A	C	D	E	F	G	H	J
G2 - 108		6-8			W					
		12-14			LL/PL SA/HA			CIU		γ_d
		16-18			W					
G2 -109		6-8			W					
		12-14			W					
		16-18			LL/PL SA/HA	CON		CIU		γ_d
G2 - 110		6-8			W					
		12-14			LL/PL SA/HA			CIU		γ_d
		16-18			W					
G2 - 111		2-4			LL/PL SA/HA			UU3		γ_d
		4-6			W					
		6-8			W					
G2 - 112		2-4			LL/PL SA/HA			UU3		γ_d
		4-6			W					
		6-8			W					
G2 - 113		2-4			LL/PL SA/HA			UU3		γ_d
		4-6			W					
		6-8			W					

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TASK 1 - TABLE 2 (CONTINUED)

GEOTECHNICAL LABORATORY TESTING PROGRAM
PLANNED FOR THE SOLID WASTE LANDFILL

Sample Location	Sample Number	Estimated Depth(ft)	Screening	Chem/RAD	Resource Conservation and Recovery Act/Geotechnical					
			A	C	D	E	F	G	H	J
G2 - 114		6-8			W,LL/PL SA/HA		HC			γ_d
G2 - 115		15-17			W,LL/PL SA/HA		HC			γ_d
G2 - 116		6-8			LL/PL SA/HA	CON				γ_d
		14-16			W,LL/PL SA/HA		HC			

(1) The actual sample numbers will be assigned at the time the samples are collected.
(2) Rad. screening on soil samples by X-ray fluorescence.
(3) The number of proposed samples is based on assumed waste depth and location of the fill/native soil interface. Additional samples may be taken if actual field conditions are significantly different, or if field or lab screening indicates multiple locations with high contaminant levels.
(4) The actual sample selected for the designated tests shall be determined in each case based on classification and condition of the recovered sample.

TARGET ANALYTE LIST DETAILS:

[A] Water/Soil - Total Uranium
[C] Soil/Sediment/Sludge/Waste- Full HSL, Full Rad., Misc. Rad.
[D] Classification Tests
SG = Specific Gravity
W = Water Content
LL = Liquid Limit
PL = Plastic Limit
Grain Size
SA = Sieve Analysis
HA = Hydrometer Analysis
Other
TOC = Total Organic Carbon
[E] CON = Consolidation Test
[F] HC = Hydraulic Conductivity
[G] Strength Tests
UU1 = Unconsolidated-Undrained Triaxial (1-specimen)
UU3 = Unconsolidated-Undrained Triaxial (3-specimen)
CIU = Consolidated Isotropic Undrained Triaxial (3-specimen)
[H] TCLP (Toxicity List)
[J] γ_d = Dry Unit Weight

See Table 3 for Summary of Geotechnical Testing Procedures.

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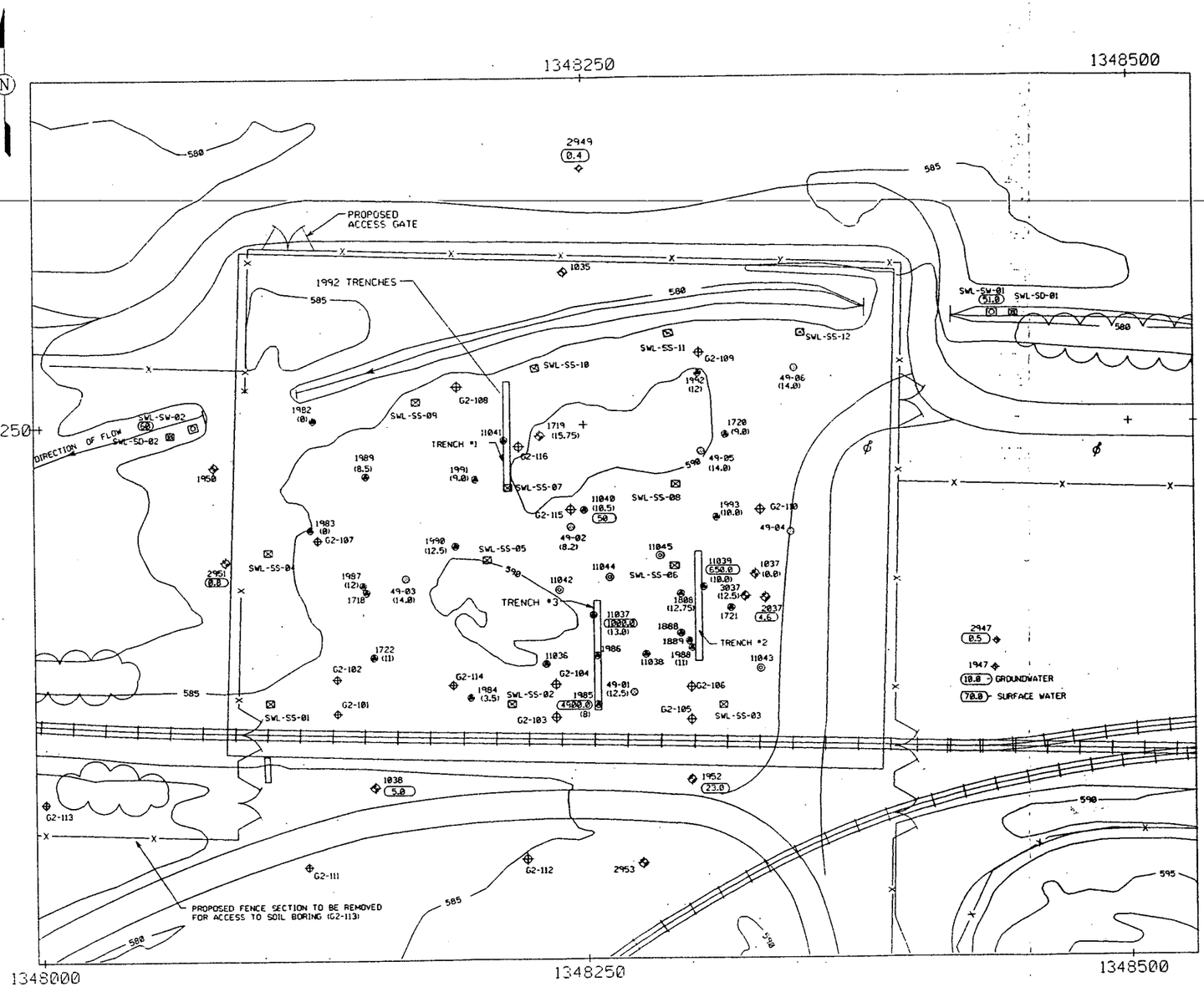
TASK 1 - TABLE 3
SUMMARY OF GEOTECHNICAL TESTING PROCEDURES

TEST NO.	TITLE
ASTM D#422-63	Standard Method for Particle Size Analysis for Soils
ASTM D#854-83	Standard Test Method for Specific Gravity of Soils
ASTM D#02435-90	Test Method for One-Dimensional Consolidation Properties of Soils
ASTM D#2216-90	Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
ASTM D#1140-42	Test Method for Amount of Material in Soils Finer than the No. 200 Sieve
ASTM D#2487-92	Test Method for classification of soils for Engineering Purposes
ASTM D#2488-90	Practice for Description and Identification of Soils (Visual-Manual Procedure)
ASTM D#2850-87	Standard Test Method for Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression
ASTM D#4220-89	Practices for Preserving and Transporting Soil Samples
ASTM D#4318-84	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D#4767-88	Test Method for Consolidated-Undrained Triaxial Compressive Test on Cohesive Soils
ASTM D#5084-90	Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
EM100-2-1906 (Army Corp. Engineers)	Dry Unit Weight

SAMPLE LOCATION TABLE					
SAMPLE ID	NORTHING	EASTING	SAMPLE ID	NORTHING	EASTING
SOIL BORINGS			SURFACE WATER SAMPLES		
49-01	482137.28	1348271.96	SWL-SW-01	482300.07	1348437.16
49-02	482283.18	1348244.05	SWL-SW-02	482258.29	1348871.52
49-03	482188.14	1348165.39	SEDIMENT SAMPLES		
49-04	482200.34	1348344.81	SWL-SD-01	482295.62	1348446.57
49-05	482237.48	1348303.81	SWL-SD-02	482246.45	1348060.61
49-06	482275.31	1348346.86	SURFACE SAMPLES		
1718	482173.89	1348158.47	SWL-SS-01	482123.78	1348185.68
1720	482245.12	1348314.38	SWL-SS-02	482122.41	1348216.25
1721	482165.88	1348316.37	SWL-SS-03	482121.12	1348312.33
1722	482144.21	1348153.54	SWL-SS-04	482192.78	1348185.67
1808	482272.31	1348292.54	SWL-SS-05	482188.49	1348295.53
1888	482354.24	1348290.14	SWL-SS-06	482185.06	1348390.45
1889	482358.76	1348296.89	SWL-SS-07	482221.53	1348215.48
1982	482352.78	1348126.17	SWL-SS-08	482222.39	1348291.21
1983	482282.72	1348124.69	SWL-SS-09	482261.00	1348175.74
1984	482125.55	1348147.45	SWL-SS-10	482276.82	1348228.26
1985	482121.87	1348255.64	SWL-SS-11	482290.61	1348286.74
1986	482144.28	1348255.58	SWL-SS-12	482291.45	1348349.25
1987	482177.82	1348148.93	PLANNED GEOTECHNICAL SOIL BORINGS		
1988	482147.55	1348298.14	G2-101	482178.56	1348136.58
1989	482226.99	1348150.48	G2-102	482134.27	1348136.45
1990	482194.84	1348176.26	G2-103	482116.12	1348236.49
1991	482205.58	1348288.48	G2-104	482131.12	1348236.48
1992	482272.49	1348381.82	G2-105	482114.57	1348247.59
1993	482207.23	1348304.98	G2-106	482124.57	1348247.59
11836	482148.58	1348232.28	G2-107	482197.93	1348128.81
11837	482162.73	1348253.89	G2-108	482267.99	1348192.31
11838	482144.68	1348277.52	G2-109	482282.74	1348382.48
11839	482175.44	1348383.82	G2-110	482218.60	1348330.21
11840	482218.83	1348249.97	G2-111	482045.67	1348122.58
11841	482243.31	1348213.66	G2-112	482051.78	1348222.53
MONITORING WELLS			G2-113	482078.88	1348081.58
1835	482328.88	1348241.49	G2-114	482131.27	1348189.73
1837	482181.28	1348327.63	G2-115	482211.13	1348244.86
1838	482186.63	1348153.47	G2-116	482240.19	1348228.41
1719	482244.97	1348238.21	PLANNED ENVIRONMENTAL SOIL BORINGS		
1947	482137.48	1348437.82	11842		
1950	482231.58	1348088.64	11843		
1952	482087.13	1348297.43	11844		
2837	482178.37	1348332.18	11845		
2947	482149.42	1348437.72			
2949	482367.58	1348241.22			
2951	482188.28	1348865.74			
2953	482044.48	1348275.23			
3837	482178.83	1348332.99			



LEGEND	
—x—	FENCE
	RAILROAD
ϕ	LIGHT POLE
	TREE LINE
	RIVER, STREAM
580	MAJOR CONTOUR
	MINOR CONTOUR
	PAVED ROADWAY
	UNPAVED ROADWAY
	APPROXIMATE SUBUNIT BOUNDARY
2134	EXISTING MONITORING WELL
1721	EXISTING BORING LOCATION
	EXISTING SURFACE SOIL SAMPLE LOCATION
	EXISTING SURFACE WATER SAMPLE LOCATION
	EXISTING SEDIMENT SAMPLE SAMPLE LOCATION
(12)	DEPTH OF EXPLORATION (FT)
50	TOTAL URANIUM (ug/L)
PROPOSED SAMPLE LOCATIONS	
G2-108	GEOTECHNICAL SOIL BORINGS
1721	ENVIRONMENTAL SOIL SAMPLES

20 0 20 40 60
SCALE IN FEET

FERNALD ENVIRONMENTAL
FERMCO
RESTORATION MANAGEMENT CORPORATION

REF. NO.:____ DATE:____ APPROVED:____ DATE:____
REF. NO.:____ DATE:____ APPROVED:____ DATE:____
REF. NO.:____ DATE:____ APPROVED:____ DATE:____
REF. NO.:____ DATE:____ APPROVED:____ DATE:____

NOTES:
1. EXISTING WELL 1037 IS ABANDONED.
2. ALL PLANNED SAMPLE LOCATIONS ARE APPROXIMATE AND SUBJECT TO ADJUSTMENT IN THE FIELD.
3. COORDINATES ARE IN STATE PLANE NAD 1983.
4. DRAWING IS BASED ON 1992 AERIAL PHOTOGRAPHS.

DRAFTER:	
DESIGN FILE:	/usr/pc99tp4/maps/swlgstpl.dgn
DEPARTMENT:	
DWG. NO.:	swlgstpl
DATE:	9-30-93

TASK 1 - FIGURE 1
SOLID WASTE LANDFILL SAMPLE LOCATIONS

REV 2

TASK 2: GEOTECHNICAL SAMPLING AND TESTING AT PROPOSED OU2 ON-SITE WASTE DISPOSAL CELL

1.0 GENERAL

1.1 Summary

The Work Plan for Operable Unit 2 (OU2) Geotechnical Sampling and Testing has been developed to implement a post-screening geotechnical investigation to obtain remedial design data for evaluation of the proposed On-site Waste Disposal Cell. This investigation, hereinafter called a predesign field investigation (PFI), will include both geotechnical and environmental sampling. Laboratory analysis and data evaluation will be performed to support the PFI. Information obtained from the PFI will be used to design the OU2 Waste Disposal Cell.

The proposed RCRA-type waste cell concept involves an essentially above ground waste containment structure with a soil/geosynthetics composite liner and cap. The planned location of the cell is presented in Figures 1 and 1A at the end of this Work Plan.

1.2 References

The environmental work associated with this Work Plan will make use of protocols set forth in the Fernald Environmental Management Project (FEMP) Sitewide CERCLA Quality Assurance Project Plan where appropriate.

Work will conform to health and safety requirements as specified in 29CFR1910 and 1926, and as documented in the FEMP's Site Health and Safety Plan.

Field radiological contamination surveys will be conducted in accordance with FEMP Health and Safety Department procedures.

The publications listed below also form part of this Work Plan:

- ASTM (American Society for Testing and Materials) Standards
- U.S. Army COE Earth Manual

2.0 SITE CONDITIONS

2.1 Previous Investigation

The northeast portion of the Waste Cell Site is the subject of an ongoing investigation by FERMCO entitled "Project Specific Plan for FEMP Trap Range Investigation." This investigation will be reviewed and incorporated in the geotechnical data evaluation as appropriate.

The exploration locations for previous investigations in the general vicinity of the proposed Waste Cell Site (six existing borings 1745, 1746, 1747, 1748, 1749, and 1750; and existing monitoring well 2400) are shown on the attached Figure 1.

2.2 Ground Conditions

The previous investigation indicates that the soils at the Waste Cell Site within the depth affecting the geotechnical performance of the cell consist predominantly of silty clays with some silts. The consistency varies typically from soft to hard and the moisture content varies between moist and dry. Ground water has been encountered at a depth of 63 feet in one boring near the Waste Cell Site.

3.0 EXECUTION

3.1 Field Exploration

3.1.1 Geotechnical Field Work

The geotechnical field investigation is planned to include a total of 8 investigation borings (G2-201 through G2-208) and 2 auger sampling borings (G2-209A and G2-210A) as a part of this Work Plan. The 8 planned investigation boring locations are shown on Figure 1, OU 2 Waste Cell, Proposed Geotechnical Borings.

The planned depth of each of the geotechnical investigation borings is 25 feet, except Borings G2-202 and -207 will be extended to a depth of 75 feet for stratigraphic control and verification of the ground water conditions and elevations.

The borings will be sampled to a depth of 20 feet at 2.5 foot intervals by alternating split barrel sampling and undisturbed Shelby tube sampling. Split barrel sampling only will be performed at 5 foot intervals below 20 foot depth. Standard Penetration Tests will be recorded at all split barrel sample locations.

Shelby tube samples will be obtained according to ASTM D1587, and Standard Penetration Tests with split barrel sampling according to ASTM D1586.

Sufficient representative bulk samples of soil below the topsoil layer will be obtained by auger borings at two locations, to allow compaction tests and hydraulic conductivity testing on reconstituted samples.

The selection of the actual boring and sample locations will be based on the available information from previous investigations and will consider that the investigations must provide representative geotechnical site characterization in regard to soil strength, compressibility and hydraulic conductivity.

The geotechnical field investigation program is planned to include a total of:

- 350 LF of geotechnical investigation borings
- 32 undisturbed Shelby Tube Samples
- 60 standard penetration tests and split barrel samples
- 2 bulk samples obtained by auger

Upon completion, the two 75 ft. borings will be backfilled to the surface with expandable grout using C150 Type K Portland Cement.

3.1.2 Environmental Field Work

Surface soil samples (WC2-SS-01 through WC2-SS-08) will be obtained in the vicinity of each geotechnical boring for herbicide and pesticide testing. The environmental soil sampling program is planned to include a total of 8 surface samples for herbicide and pesticide contamination testing.

Samples for environmental on-site laboratory testing will be collected from the borings if waste material is encountered or if other contamination is indicated by field screening.

3.1.3 Personal Protective Equipment

Personnel Protective Equipment used during the PFI of the Waste Disposal Cell Site will meet Level D protection requirements.

Shelby tube samples will be obtained according to ASTM D1587, and Standard Penetration Tests with split barrel sampling according to ASTM D1586.

Sufficient representative bulk samples of soil below the topsoil layer will be obtained by auger borings at two locations, to allow compaction tests and hydraulic conductivity testing on reconstituted samples.

The selection of the actual boring and sample locations will be based on the available information from previous investigations and will consider that the investigations must provide representative geotechnical site characterization in regard to soil strength, compressibility and hydraulic conductivity.

The geotechnical field investigation program is planned to include a total of:

- 350 LF of geotechnical investigation borings
- 32 undisturbed Shelby Tube Samples
- 60 standard penetration tests and split barrel samples
- 2 bulk samples obtained by auger

Upon completion, the two 75 ft. borings will be backfilled to the surface with expandable grout using Type H Portland Cement.

3.1.2 Environmental Field Work

Surface soil samples (WC2-SS-01 through WC2-SS-08) will be obtained in the vicinity of each geotechnical boring for herbicide and pesticide testing. The environmental soil sampling program is planned to include a total of 8 surface samples for herbicide and pesticide contamination testing.

Samples for environmental on-site laboratory testing will be collected from the borings if waste material is encountered or if other contamination is indicated by field screening.

3.1.3 Personal Protective Equipment

Personnel Protective Equipment used during the PFI of the Waste Disposal Cell Site will meet Level D protection requirements.

3.2 Laboratory Testing

3.2.1 Geotechnical Laboratory Testing Program

The geotechnical testing procedures are summarized in Table 1. The samples actually selected for particular tests will be determined based on the encountered soils conditions and sample characteristics. The samples will be sent to a geotechnical laboratory.

The approximate number of tests to be performed for each method is as follows:

TEST METHOD	NUMBER OF TESTS
Moisture Content	30
Grain-Size Analysis (SA/HA)	35
Atterberg Limits	35
Specific Gravity	4
Unit Weight	15
Hydraulic Conductivity (reconstituted)	4
Standard Proctor Compaction Tests	4
Triaxial Compression (CIU,w/pp; undisturbed) Each CIU Test will include 3 specimens of different confining pressure	8*
Triaxial Compression (CIU,w/pp; reconstituted) Each CIU Test will include 3 specimens of different confining pressure	4
Hydraulic Conductivity (undisturbed)	4*
Consolidation Tests	3*

*These tests should be taken from the Shelby tube samples.

3.2.2 Environmental Laboratory Testing Program

Samples collected from the environmental field work will be sent to the on-site FERMCO laboratory for analysis. The quantity of samples needed will be coordinated with the laboratory.

4.0 PREDESIGN ACTIVITIES AND EVALUATION REPORT (PAER).

The data collected during the PFI, including data collected during previous site investigations and studies, will be the basis for the geotechnical analysis and design of the Waste Cell. A supplementary geotechnical investigation may be undertaken depending upon the subsurface conditions reported in the PFI, and considering final Cell location and design configuration. The findings of the PFI will be summarized

in a PAER. The PAER will contain all boring logs, laboratory test results and data evaluations. Draft copies of laboratory test results will be provided to FERMCO as they become available or as requested by FERMCO.

The PAER will include, but not necessarily be limited to, the following information:

1. Description of laboratory tests.

2. List of laboratory test procedures used and variations, if any.

3. Summary of laboratory test data indicating, when applicable:

   - boring number
   - sample ID
   - USCS symbol (see note)
   - dry unit weight (pcf)
   - Atterberg Limits
   - grain size distribution
   - triaxial test type (CIU)
     - data - figure
     - u (psi)
     - σ_3 (psi)
     - $(\sigma_1 - \sigma_3)$ (psi)
   - initial void ratio e_o
   - coefficient of Consolidation C_c

   Note: Field classifications according to ASTM D#2488 will be verified by comparison to ASTM D#2487 results.

4. Gradation curves

5. Consolidation test curves

6. Triaxial test diagrams illustrating Mohr's circles (for total and effective stress (when applicable), rupture line, and strain vs. stress and pore pressure curves (when applicable).

7. Plasticity charts

8. Compaction curves

9. Hydraulic conductivity test results including permeability v.s. test duration.

The PAER will present geotechnical evaluations and recommendations regarding the location, depth and characteristics of the soil layers to be used for assessment of the slope stability and settlement of the waste cell together with the design parameters for total shear strength (c, ø) and effective shear strength ($\bar{c}$, $\bar{ø}$), compression including undrained deformation and time dependent consolidation, and unit weights. The recommendations will also include parameters for hydraulic conductivity of the soils in natural and compaction remolded state.

The subsurface stratigraphy will be presented on appropriate cross sections showing the boring results, including previous investigation results, together with a geologic interpretation of the stratigraphy within the waste cell site.

The PAER will in a separate section address the environmental sampling program and test results.

5.0 QA/QC PROGRAM

All environmental activities will be performed in accordance with the Sitewide CERCLA Quality Assurance Project Plan. The Analytical Support Levels for chlorinated pesticides, organophosphorus pesticides, and herbicides will be C, B, and B, respectively.

The QA/QC Program for geotechnical activities will be separate and will consist of the following elements:

1. Management and supervisory overview to ensure compliance with all plans, procedures, rules and regulations, and referenced standards for performance of the Work Plan activities.

2. Organization and assignment of key personnel for execution of the Work Plan.

3. Training and qualifications of all assigned personnel relevant to their responsibilities, tasks and required skill level.

4. Procedures for the technical performance of all field and laboratory tests. Identification and implementation of recognized standards will satisfy this requirement.

5. Current calibration of all measurement and test equipment.

6. Control of all information and data to provide traceability from the origin to the final report.

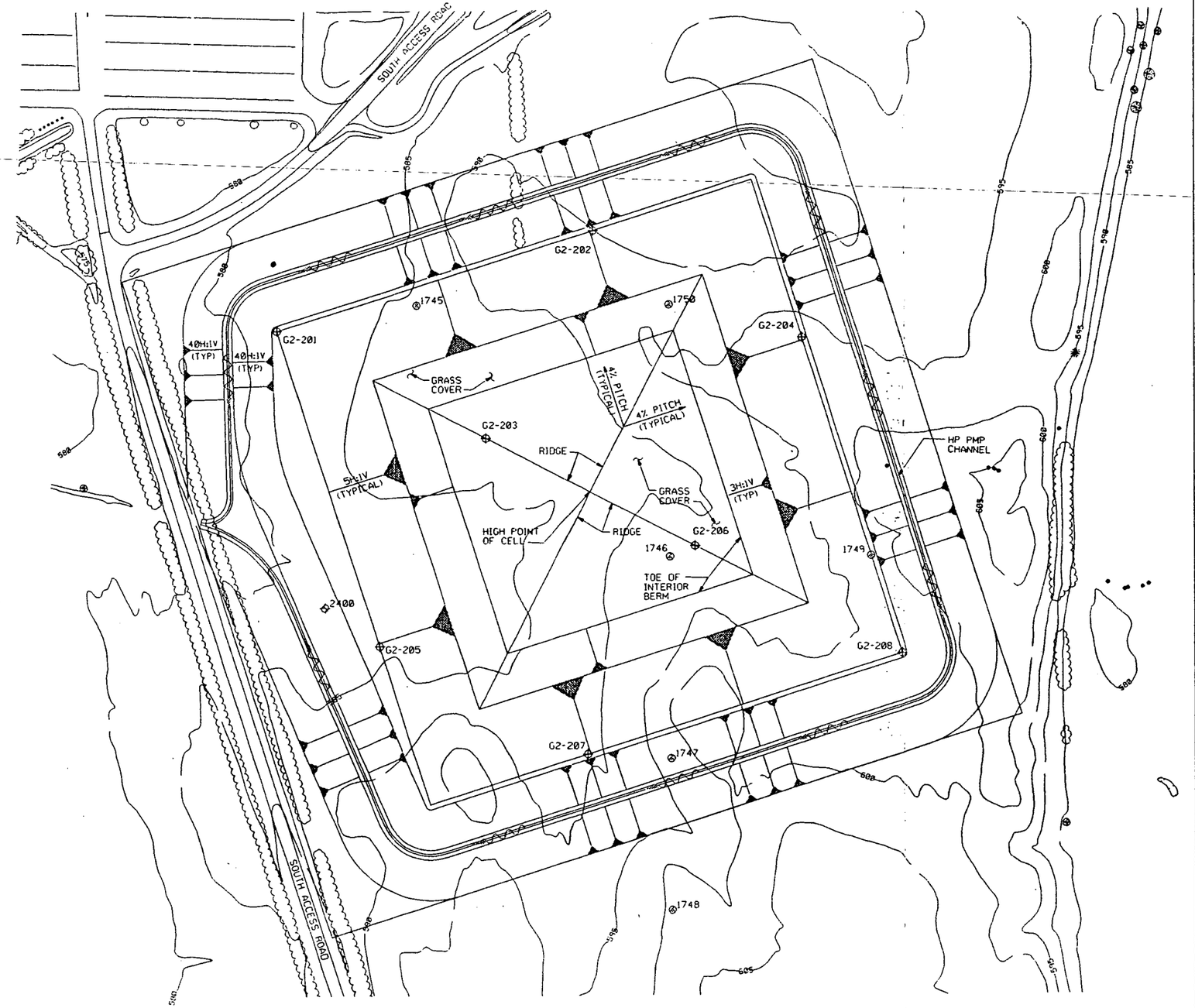
7. Design control for all data compilations, evaluations, analyses, and report preparation including supervisory review, checking and technical peer review.

8. Procedures for identification and control of non-conformances from the QA/QC program requirements and resulting corrective actions.

TASK 2 - TABLE 1
SUMMARY OF GEOTECHNICAL TESTING PROCEDURES

TEST NO.	TITLE
ASTM D#422-63	Standard Method for Particle Size Analysis for Soils
ASTM D#698-91	Test Method for Laboratory Compaction Characteristics of Soils Using Standard Effort.
ASTM D#854-83	Standard Test Method for Specific Gravity of Soils
ASTM D#1140-42	Test Method for Amount of Material in Soils Finer Than the No. 200 Sieve
ASTM D#2216-90	Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
ASTM D#2435-90	Test Method for One-Dimensional Consolidation Properties of Soils.
ASTM D#2487-92	Test Method for classification of soils for Engineering purposes
ASTM D#2488-90	Practice for Description and Identification of Soils
ASTM D#4220-89	Practices for Preserving and Transporting Soil Samples
ASTM D#4318-84	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D#4767-88	Test Method for Consolidated-Undrained Triaxial Compressive Test on Cohesive Soils
ASTM D#5084-90	Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
EM100-2-1906 (Army Corp. Engineers)	Dry Unit Weight
EM100-2-1906 App. X	Triaxial Compression Testing

SAMPLE ID	EASTING	NORTHING
EXISTING BORINGS		
1745	1350531.02	478529.41
1746	1351031.03	478029.42
1747	1351031.03	477629.42
1748	1351031.03	477329.42
1749	1351431.03	478029.42
1750	1351031.02	478529.41
EXISTING MONITORING WELL		
2400	1350346.84	477928.89
PLANNED GEOTECHNICAL INVESTIGATION BORINGS		
G2-201	1350255.04	478478.74
G2-202	1350881.65	478677.37
G2-203	1350567.66	478264.75
G2-204	1351294.27	478463.39
G2-205	1350453.68	477852.14
G2-206	1351080.28	478050.77
G2-207	1350866.30	477638.15
G2-208	1351492.90	477836.78
PLANNED AUGER SAMPLING BORINGS		
G2-209 A	TO BE LOCATED BY A-E	
G2-210 A	TO BE LOCATED BY A-E	
PLANNED SURFACE SAMPLES (PESTICIDES & HERBICIDES)		
WC2-SS-01	TO BE LOCATED BY A-E	
WC2-SS-02	TO BE LOCATED BY A-E	
WC2-SS-03	TO BE LOCATED BY A-E	
WC2-SS-04	TO BE LOCATED BY A-E	
WC2-SS-05	TO BE LOCATED BY A-E	
WC2-SS-06	TO BE LOCATED BY A-E	
WC2-SS-07	TO BE LOCATED BY A-E	
WC2-SS-08	TO BE LOCATED BY A-E	



80 0 80 160 240
SCALE IN FEET

FERMCO
RESTORATION MANAGEMENT CORPORATION
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

LEGEND
- ⊕2400 EXISTING MONITORING WELL
- @1748 EXISTING SOIL BORING
- ⊕G2-209 PLANNED GEOTECHNICAL BORING

NOTES: THE OU-2 WASTE CELL IS PROPOSED. IT IS SHOWN TO IDENTIFY THE SAMPLING LOCATIONS RELATIVE TO THE PROPOSED CELL. EXISTING SITE DATA ON PLANT FILES IS FROM PARSONS TOPOGRAPHY, 1992 COORDINATES ARE IN STATE PLANE, NAD 1983.

DRAFTER:	
DESIGN FILE:	/usr/po99to4/maps/swlastp2.dgn
DEPARTMENT:	
DWG. NO.:	swlgstp2.dgn
DATE:	9-30-93

TASK 2 - FIGURE 1
OU-2 WASTE CELL
PROPOSED GEOTECHNICAL BORINGS

REV 1

FEMP NORTH

STATE OF OHIO NORTH (NAD 83)

1.5672°

E0000 N2000

E2000

E4000

E6000

E8000 N2000

ST. ROUTE 126

MORGAN-ROSS RD.

EXISTING RAILROAD SPUR

BUTLER CO. HAMILTON CO.

N0000

OU-1

OU-2

OU-3

NORTH ACCESS RD.

S2000

S4000

PROPOSED CELL FOR OU-2 WASTE

SEE TASK 2 - FIGURE 1 FOR SAMPLING PLAN

EXISTING STORM WATER RETENTION BASIN

PADDY'S RUN RD.

SOUTH ACCESS RD.

ST. ROUTE 128

E0000 S6000

S6000

WILLEY RD.

500 0 500 1000 1500

SCALE IN FEET

LEGEND

EXISTING	PROPOSED
COUNTY LINE	
OU BOUNDARY	
EXISTING SITE BOUNDARY	
	PMP CHANNEL (PROBABLE MAXIMUM PRECIPITATION)
	TOP OF SLOPE
	TOE OF SLOPE

FERNALD ENVIRONMENTAL

FERMCO

RESTORATION MANAGEMENT CORPORATION

TASK 2 - FIGURE 1A
GENERAL LOCATION MAP
OU2 PROPOSED ON-SITE
WASTE CELL

DRAFTER: WILLIAMS		0026
DESIGN FILE: c111793.dgn		
DEPT.: G.I.S.	DATE: 11-2-93	REV
DWG. NO.: C11-1793		